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Wells

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[54] **EXTENDED RANGE VARIATOR**

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[52] **U.S. Cl.** **74/348**

[51] **Int. Cl.** **F16h 3/22**

[58] **Field of Search** 74/348

[56] **References Cited**

UNITED STATES PATENTS

2,198,879	4/1940	Mayo	74/348
3,413,867	12/1968	Hamlin	74/348
3,708,113	1/1973	Katakura et al.	74/348 X

Primary Examiner—Leonard H. Gerin
Attorney, Agent, or Firm—Prutzman, Hayes, Kalb & Chilton

[57] **ABSTRACT**

Conversion of a conventional mechanical fuel pump price setting variator for extending the conventional three place unit volume price range of the variator to a four place unit volume price range and comprising an auxiliary multiple step cone gear radially offset from and driven by the primary multiple step cone gear and selectively engageable by the conventional highest order range arm to extend its available price range into an additional higher order place, and auxiliary price indicator means operable by the highest order range arm to display the highest two places of an established price within the extended price range.

8 Claims, 4 Drawing Figures

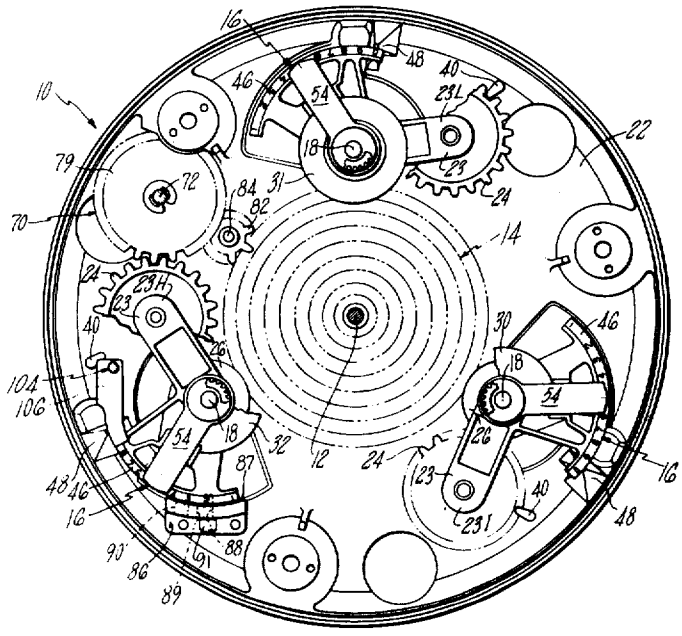


FIG. 1

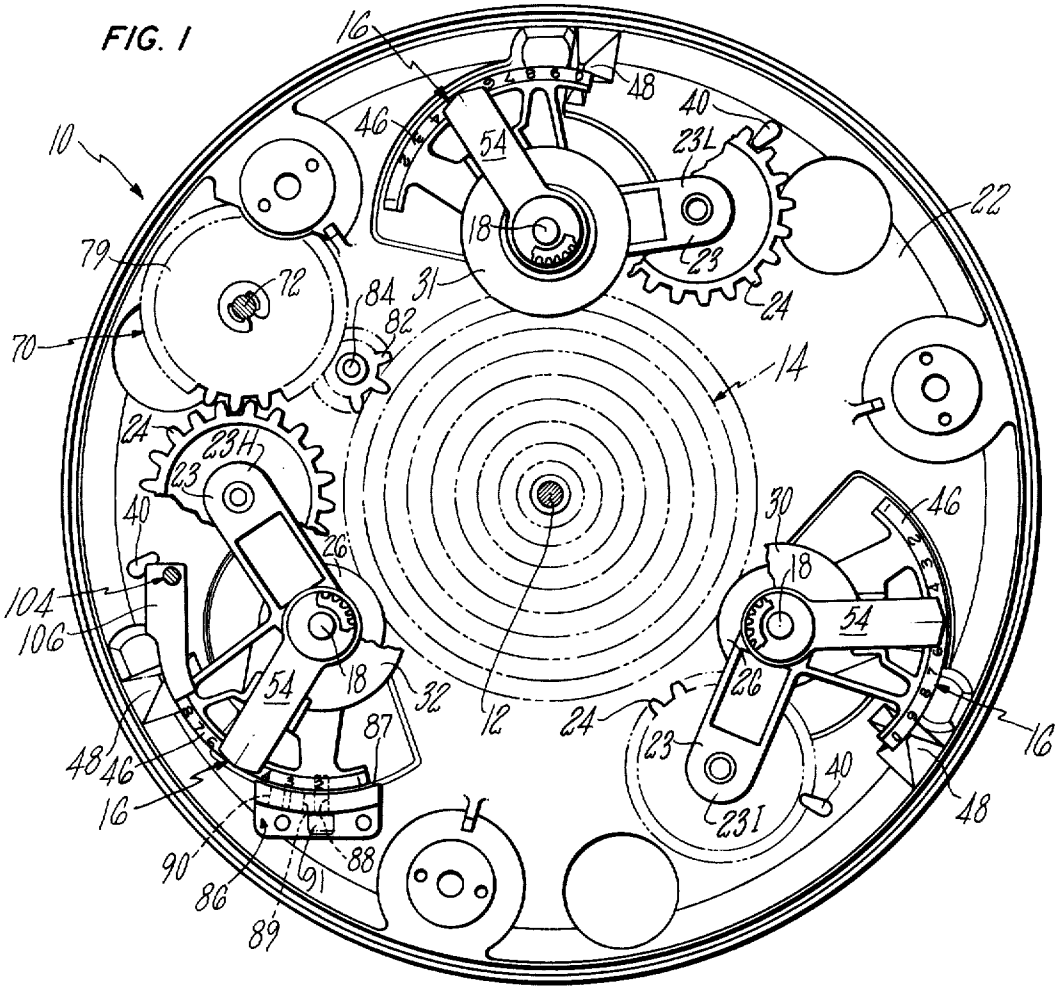

16
48
40
46
54
23L
10
22
18
79
72
84
31
23
24
82
70
14
24
23H
23
40
26
30
46
104
106
18
54
54
18
32
87
12
24
26
16
48
46
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16
23I
48
90
88
86
91
89

FIG. 2

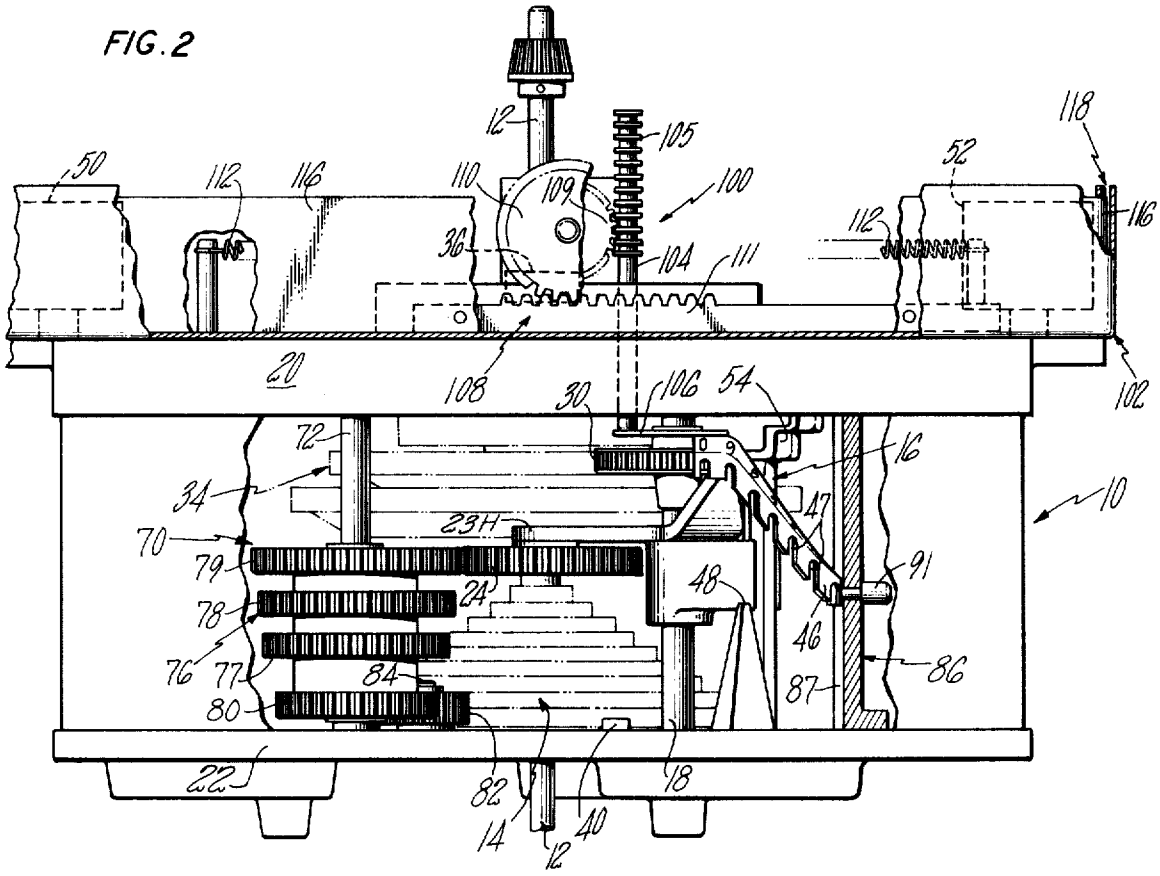


FIG. 3

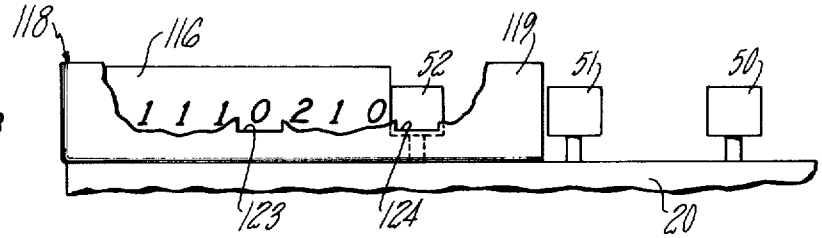
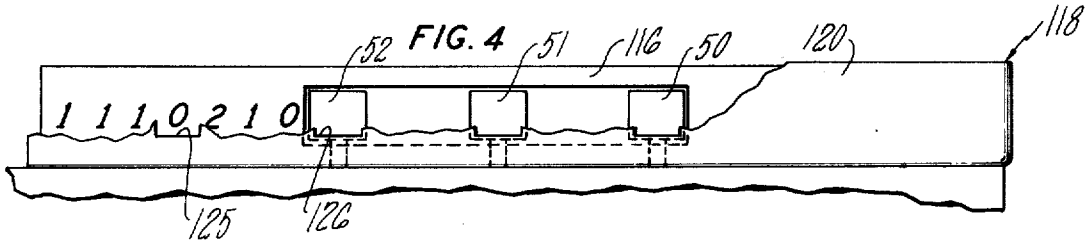


FIG. 4



EXTENDED RANGE VARIATOR

BRIEF SUMMARY OF THE INVENTION

The present invention relates generally to conventional mechanical variators of the type disclosed in U.S. Pat. No. 3,413,867 of Richard B. Hamlin dated Dec. 3, 1968 and entitled VARIATOR and having notable use in fuel dispensing equipment for establishing and posting the unit volume price of gasoline within an available multiple place price range of the variator and more particularly relates to the conversion of such mechanical variators to increase the available price range of the variator.

Because of the increasing cost of gasoline, the price for a gallon of gasoline may now exceed the maximum available three place unit volume price of 499 (e.g. 49.9 cents per gallon) of conventional "limited" range variators in the field and in the not too distant future may exceed the maximum available three place unit volume price of 999 (e.g. 99.9 cents per gallon) of conventional "full" range variators in the field.

It is therefore a principal aim of the present invention to provide conversion means for modifying conventional mechanical variators for extending their available multiple place unit volume price range.

It is another aim of the present invention to provide new and improved variator conversion means of the type described which does not substantially increase the variator torque load on its driving fuel meter and which permits conversion of existing fuel pump equipment with minimum inconvenience and down time.

It is another aim of the present invention to provide new and improved variator conversion means for extending the available multiple place unit volume price range of a conventional variator and for posting the established price setting of the variator within the extended price range of the variator.

It is a further aim of the present invention to provide a new and improved mechanical variator having an extended multiple place unit volume price range.

It is another aim of the present invention to provide a new and improved mechanical variator settable to establish a drive ratio within a four place drive ratio range.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

A better understanding of the invention will be obtained from the following detailed description and the accompanying drawings of an illustrative application of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a transverse section view, partly broken away and partly in section of a variator modified in accordance with the present invention;

FIG. 2 is a partial elevation view, partly broken away and partly in section of the modified variator; and

FIGS. 3 and 4 are reduced partial elevation views, partly broken away and partly in section showing the indicator faces of the modified variator.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail wherein like reference numerals indicate like parts throughout the several figures, there is shown a mechanical variator or change speed mechanism of the type disclosed in the

aforementioned U.S. Pat. No. 3,413,867 and conventionally used in gasoline dispensing equipment for establishing and posting the unit volume price of the gasoline delivered within a multiple place unit volume price range (e.g., from 00.0 cents per unit volume to 99.9 cents per unit volume in 1 cent increments).

The variator **10** may be identical to the variator shown and described in U.S. Pat. No. 3,413,867 excepting as hereinafter described and therefore will not be totally described in detail herein. Briefly, however, the variator **10** comprises a center shaft **12** adapted for example to be driven by a conventional fuel meter (not shown) of a gasoline dispensing system in accordance with the volume amount of gasoline dispensed. A nine step cone gear or gear stack **14** having gear steps **1–9** with respective numbers of teeth in accordance with the arithmetic progression **1***a*; **2***a* . . . **9***a* (e.g., 8, 16, 24, . . . 72) is mounted on the center shaft **12** for being driven by the shaft **12.** Three range arms or take-off gear assemblies **16,** comprising three parallel angularly spaced range arm shafts **18** rotatably mounted on the top **20** and base **22** of the variator frame are provided for selective engagement with the gear steps **1–9** of the cone gear **14.** Each range arm assembly **16** has a range arm **23** pivotally and slideably mounted on the respective range arm shaft **18** and adapted to be pivotally and axially positioned for selective engagement of its outer range arm idler gear **24** with each of the steps **1–9** of the central cone gear **14.** An inner range arm gear **26** in mesh with the idler gear **24** is keyed to the range arm shaft **18** for rotating that shaft. A respective range arm output gear **30-32** affixed to the range arm shaft **18** provides an input into a differential summing mechanism **34** having an output gear **36** rotatably mounted on the variator center shaft **12.** The relative gear ratios throughout the three range arms **23** to the variator output gear **36,** via the range arm output gears **30–32** and differential summing mechanism **34,** are in accordance with the geometric progression **1***b*, **10***b*, **100***b* such that one of the range arms **23L** operates as a lowest place range arm to set the amount of the lowest place of a three place unit volume price, a second range arm **23** operates as an intermediate place range arm for setting the amount of the intermediate place of the three place unit volume price, and the remaining range arm **23H** operates as a highest place range arm for setting the amount of the highest place of the three place unit volume price. Thus, for example, with all three range arms in engagement with the lowest and largest gear step (e.g., having 72 teeth) the established unit volume price is 999 (e.g., 99.9 cents per gallon), and with all three range arms in engagement with the highest and smallest gear step (e.g., having 8 teeth) the established unit volume price is 111 (e.g., 11.1 cents per gallon). Also each range arm **23** may be selectively positioned in a lower position out of engagement with the cone gear **14** and with its idler gear **24** in engagement with a fixed tooth **40** integrally formed on the base **22** such that the range arm output is locked against rotation to, in effect, establish a 0 for the respective place of the multiple place unit volume price. Thus, it can be seen that the three range arms can be selectively shifted into engagement with the respective fixed teeth **40** and the cone gear steps **1–9** to establish any unit volume price within a multiple place price range of 000 to 999.

The variator output gear **36** therefore provides an output which is adapted to be connected for example

to the conventional fuel pump register cost counters (not shown) for accumulating and registering the cost of the gasoline delivered in accordance with the volume of gasoline delivered and a three place unit volume price established by the settings of the three variator range arms **23**. The variator center shaft **12** is also adapted to be connected for example to the conventional fuel pump register volume counters (not shown) for accumulating and registering the volume amount of the gasoline delivered.

Each range arm **23** has a notched generally helical detent rack **46** with ten notches **47** for the 10 positions of the range arm **23**, and the base **22** is formed with a fixed integral detent finger **48** for each range arm for receipt within each of the ten notches **47** of the range arm **46** for accurately positioning the range arm idler gear **24** in angularly and vertically correlated positions for engagement with the fixed lock out tooth **40** and the steps **1–9** of the cone gear.

The variator **10** has a set of three aligned numeral price posting wheels **50–52** of ascending order of significance, each bearing a sequence of indicia of 0–9, on each of two opposed sides of the variator **10**. Each numeral wheel **50–52** is mechanically connected to a bail **54** of the respective range assembly **16** to be angularly positioned in accordance with the pivotal position and therefore the setting of the respective range arm **23**. Also the indicia 0–9 on each numeral wheel are angularly spaced so that each set of numeral wheels provides for posting the three place unit volume price from 000 to 999 established by the range arm settings.

In accordance with the present invention the variator **10** described above and as more fully disclosed in the aforementioned U.S. Pat. No. 3,413,867, is modified to expand or extend the unit volume price range of the variator, in the shown embodiment from three places to four places and from 999 to 1299, and to automatically post the unit volume price (not only through the standard range of 000 through 999 but) through the extended price range.

Pursuant to the present invention, an auxiliary integral multiple gear stack **70** is rotatably mounted on an auxiliary shaft **72** extending parallel to and radially offset from the center shaft **12** and mounted on the base **22** and top **20** of the variator frame. The auxiliary gear stack **70** shown in the drawings comprises a three step auxiliary cone gear or gear stack **76** with gear steps **77–79** and with its largest gear **79** at the top and its smallest gear **77** at the bottom and such that the auxiliary cone gear **76** is inverted relative to the primary cone gear **14**. The three gear steps **77–79** of the auxiliary cone gear **76** have respective numbers of teeth in accordance with the arithmetic progression **10***c*, **11***c*, **12***c*. The auxiliary gear stack **70** also comprises a lower integral drive gear **80** which is driven by the largest gear step **9** of the primary cone gear **14** via an idler gear **82** and whereby the auxiliary gear assembly **70** is rotated by the variator center shaft **12** in the same angulalr direction as the primary cone gear **14**.

The idler gear **82** is rotatably mounted on an auxiliary shaft **84** mounted on the variator frame. The idler gear shaft **84** and auxiliary cone gear shaft **72** are angularly positioned relative to the range arm shafts **18** so as not to interfere with the pivotal movement of the range arms **23**. Also the axis of the auxiliary cone gear **76** is angularly and radially positioned relative to the axes of the variator center shaft **12** and the highest order range arm **23H** so that the highest order range arm **23H** is adapted to be pivotally and vertically positioned for selective engagement of its idler gear **24** with each of the auxiliary cone gear steps **77–79** within the available vertical and pivotal limits of the range arm **23H** and without interfering with the engagement of the range arm **23H** with the primary cone gear steps **1–9** and respective range arm lock-out tooth **40**. The auxiliary cone gear **76** may be positioned to provide outward pivotal movement of the range arm into selective engagement with the auxiliary gear steps **77–79** and/or, as shown, to provide inward pivotal movement of the range arm into selective engagement with the gear steps **77–79** after initial pivotal movement of the range arm **23H** outwardly of and below the auxiliary cone gear **76**.

A suitable auxiliary range arm detenting devicie **86** is provided for selectively locking the range arm **23H** in each of its auxiliary positions. The detenting device **86** comprises an arcuate plate **87** having suitable positioned apertures **88–90** for the three additional ranges and a locking pin **91** adapted to be selectively inserted through the apertures **88–90** and into a suitable aperture in the highest order range arm detent rack **46**.

The number of teeth n on the auxiliary cone drive gear **80** is equal to $a \times c$ (i.e. $n=a \times c$) where a and c are the whole number constants of the arithmetic progressions of the numbers of teeth of the primary and auxiliary cone gear steps **1–9** and **77–79** respectively. In the conventional variator a is 8, and although c might be any whole number from 1 to 8, it has been found preferable to use an intermediate but relatively low value for b, for example 3, (in which case the auxiliary cone gear steps **77–79** have 30, 33 and 36 teeth respectively and the cone drive gear **80** has 27 teeth) to provide an auxiliary cone gear **76** remaining within the existing peripheral confines of the variator **10** and yet providing auxiliary gear steps **77–79** which have an adequate number of teeth to prevent excessive gear tooth loading and tooth wear.

It can therefore be seen that the auxiliary gear steps **77–79** provide additional range arm drive ratios for the highest order range arm 23H of 10, 11 and 12 relative to the gear ratios 1–9 provided by the gear steps **1–9** of the primary cone gear **14**. Accordingly, the highest order range arm 23H can be selectively set into engagement with each of the auxiliary cone gears **77–79** to expand the available relative gear ratios, and therefore the unit volume prices in a fuel pump installation, beyond 9-- to 12--, the values of the lowest two places continuing to be set by the lowest and intermediate price range arms **23L** and **23I**.

An auxiliary price posting mechanism **100** is provided for automatically posting the unit volume price through the extended range from 9-- to 12--. The auxiliary price posting mechanism **100** comprises an auxiliary frame **102** shown mounted on the variator top **20** to extend along one side of the variator and such that it would be clear of the gasoline pump register (not shown) conventionally mounted on the variator **10**.

An auxiliary range arm sensor rod or slide **104** having an upper end formed to provide a rack **105** is mounted on the auxiliary frame **102** to extend through a suitable opening in the top **20** parallel to the variator shafts **12**, 18, 72, 84. The sensor rod **104** is mounted to be axially shifted upwardly from a lower withdrawn position by the highest order range arm **23H** as that range arm is

axially shifted upwardly for engagement with the three auxiliary cone gear steps **77–79.** A rod actuating plate **106** is secured to the upper end of the detent rack **46** of the range arm **23H** for engaging and raising the sensor rod **104** as the range arm **23H** is raised for engagement with each auxiliary cone gear step **77–79.** The vertical position of the sensor rod **104** is therefore a function of the setting of the range arm. The plate **106** is suitably contoured so that it does not engage the sensor rod **104** when the range arm **23H** is in engagement with or is being adjusted into engagement with the primary range gears **1–9** of the center cone gear **14.**

A slide **108** is reciprocably mounted on the auxiliary frame **102** for movement generally perpendicular to the parallel price readout planes of the opposed sets of price wheels **50–52** of the variator **10.** The slide **108** is connected via pinions **109, 110** respectively engaging the rack **105** of the sensor rod **104** and a rack **111** of the slide **108** to be shifted in one direction, to the right as viewed in FIG. **2,** as the sensor rod **104** is axially shifted upwardly by the range arm **23H.** A tension spring **112** is connected between the frame **102** and slide **108** to return the slide **108** and rod **104** in the opposite directions as the range arm **23H** is lowered.

A flat plastic auxiliary indicator band or tape **116** is secured to the slide **108,** and the frame **102** is formed with a band guideway **118** for receiving and guiding the band **116.** The guideway has a pair of sections **119, 120** in the two opposed price readout planes of the variator and the band **116** is made suitably flexible to permit it to be laterally shifted by the slide **108.** The band guideway sections **119, 120** are formed with pairs of windows of **123, 124** and **125, 126** respectively for selectively posting the highest two places of the four place unit volume price as established by the variator setting. The highest place windows **123, 125** are provided in lateral alignment with and to the left of the respective set of price numeral wheels **50–52.** The next highest place windows **124, 126** are mounted over the highest place price wheels **52** to permit reading those wheels when the highest order range arm **23H** is set into engagement with the steps **1–9** of the primary cone gear **14.**

A set of a sequence of indicia of "0", "1" and "2" is provided on the indicator band **116** for cooperation with each next highest place window **124, 126** such that the 0," "1" and "2" are individually centered in the respective window **124, 126** when the highest place range arm **23H** is in operative engagement with the lowest, intermediate and highest auxiliary cone gear steps **77–79** respectively. Also, a set of a sequence of indicia of "0," "1," "1" and "1" is provided on the indicator band **116** for cooperation with each highest place window **123, 125** such that the "0" (or alternatively merely a blank if desired) is centered in each highest place window **123, 125** when the range arm **23H** is in engagement with one of the steps of the primary cone gear **14,** and a "1" is centered in each highest place window **123, 125** when the range arm **23H** is in engagement with each auxiliary cone gear step **77–79.**

Alternatively, an auxiliary price posting mechanism may be employed wherein the highest place and next highest place auxiliary price numerals are provided on a pair of auxiliary numerals drums or wheels (not shown) suitably connectd to be rotated by the sensor rod **104,** and whereby the next highest place auxiliary price drum (not shown) would be mounted coaxially around the wheel **52** and have a window for reading the highest place price wheel **52** and bear the numerals "0," "1" and "2" for posting the extended price values for that place. Similarly the highest place auxiliary price drum (not shown) would bear the indicia "0," "1," "1" and "1" for posting the price values for that place.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teachings of the present invention.

I claim:

1. In a unit volume price variator for a mechanical fuel pump computer settable for establishing the amount of each place of a multiple place unit volume fuel price and having an input adapted to be driven by a fuel meter in accordance with the volume of fuel delivered, a multiple gear primary gear stack driven by the variator input in one angular direction, a plurality of range arm assemblies for the multiple places respectively having respective range arm shafts with axes radially offset from and parallel to the axis of the primary gear stack and respective range arms shiftable pivotally and axially on the range arms shafts for selective engagement with the gears of the primary gear stack, and combining gearing for combining the range arm outputs to provide relative drive ratios through the range arms in accordance with a geometric progression having a common ratio of ten, and at least one set of a plurality of price wheels for the multiple places respectively each operably connected to the respective range arm assembly for displaying the amount of the respective place of the unit volume price established by the range arm setting, the improvement wherein the variator further comprises a multiple gear auxiliary gear stack rotatably mounted about an axis parallel to and radially offset from the axes of the primary gear stack and highest place range arm shaft for selectively pivotally and axially shifting the highest place range arm into engagement with each auxiliary gear of the auxiliary gear stack, the primary gears of the primary gear stack providing relative drive ratios in accordance with the arithmetic progression $1a; 2a; 3a; \ldots 9a;$ where a is a positive whole number, and the auxiliary gears of the auxiliary gear stack providing relative drive ratios in accordance with the arithmetic progression $10b; 11b; \ldots;$ where b is a positive whole number, and drive means for driving the auxiliary gears with the variator input in the same angular direction as the primary gears whereby the highest place range arm is engageable with the auxiliary gears to extend the available price range of the variator an additional place.

2. The variator according to claim **1** further comprising auxiliary price posting means operable by the highest place range arm to post the extended unit volume price portion of the price range of the variator.

3. A variator according to claim **2** wherein the auxiliary price posting means comprises a range arm sensor shiftable by the highest place range arm as it is shifted into engagement with the auxiliary gears and in accordance with the selected auxiliary gear, and price display means operable by the shiftable sensor to display said extended unit volume price portion.

4. A variator according to claim **3** wherein the sensor is mounted to be shiftable along an axis generally parallel to the axis of the auxiliary gear stack and to be axi-

ally shifted by the highest place range arm as it is axially shifted for engagement with the auxiliary gears.

5. A variator according to claim 4 wherein the axially shiftable sensor is out of engagement with the highest place range arm with the range arm in engagement with the gears of the primary gear stack.

6. A variator according to claim 3 wherein the price display means comprises a shiftable indicia bearing band for displaying said extended unit volume price portion and means interconnecting the band and range arm sensor for shifting the band to display said extended unit volume price portion.

7. In a settable multiple ratio variator having input and output rotary members, a rotatable primary gear stack with a plurality of primary gears with different numbers of teeth operatively connected to one of the rotary members, and at least one range arm assembly having a range arm shaft with an axis radially offset from and generally parallel to that of the primary gear stack and a range arm operatively connected to the other rotary member and pivotally and axially shiftable on the range arm shaft for selective operative engagement with each of the primary gears for operatively connecting the input and output rotary members; the improvement wherein the variator further comprises a rotatable auxiliary gear stack with a plurality of auxiliary gears with different numbers of teeth operatively connected to said one rotary member and rotatably mounted about an axis parallel to and radially offset from the axes of the primary gear stack and said range arm shaft and for selectively pivotally and axially shifting said range arm into operative engagement with each auxiliary gear of the auxiliary gear stack whereby said range arm is selectively engageable with each auxiliary gear as well as each primary gear to enlarge to available drive ratio range between the rotary input and output members of the variator.

8. A variator according to claim 7 wherein the auxiliary gear stack is operatively connected to said one rotary member to rotate in the same angular direction as the primary gear stack.

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